

What is claimed is:

1. A method for successively feeding in an arbitrary sequence batches of a liquid and a powder bone cement component into a mixing vessel under vacuum for the preparation of said bone cement, comprising the steps of: providing a mixing vessel having an open interior; providing an inner container which communicates with the atmosphere at one end and with the mixing vessel at the other end; providing a second and outer container which at least partially surrounds said inner container, wherein a space is formed between the inner container and the outer container; providing a bone cement component in powder form in said space; providing a liquid component within said inner container;

causing upward axial displacement of the inner container relative to the outer container to move said inner container from a first position in which the space does not communicate with the atmosphere or the mixing vessel, to a second position in which said space communicates with the atmosphere and the mixing vessel, so that the bone cement component in powder form can be drawn down into the mixing vessel under the effect of the partial vacuum inside it and wherein said liquid component can be drawn down into said mixing vessel under said same vacuum in order to mix said components without allowing noxious fumes to escape to atmosphere from either container.

2. An apparatus for successively feeding batches of a liquid and a powder component into an interior of a mixing vessel for preparation of a bone cement, said mixing vessel interior maintained under a vacuum created from a vacuum source, comprising:

a generally cylindrical inner container which is defined by a top, a bottom, and an interior, said inner container axially displaceable between a first and a second position, said bottom end in communication with said mixing vessel while in said first position, and while in said second position, said top end axially displaced above said mixing vessel, no longer in communication therewith, said bottom, end in communication with the atmosphere in both of said positions;

a generally outer container which is defined by a top, a bottom an outside surface and an interior, said interior of said outer container concentrically receiving at least

08968034-111257
a portion of said inner container therein, thereby defining a space between said containers, said space being filled with said powdered component of said bone cement when said inner container is in said first position, said outside surface near said bottom end of said outer container being threaded;

an interlocking cover connected to said bottom end of said outer container, said cover having a top and a bottom surface and a downwardly depending edge, said edge including a threaded internal surface for screwed engagement to said threads of said outer container, said cover including a threaded and centrally located throughbore which receives said inner container therethrough, said throughbore and said interior of said outer container being sealed from communication with the atmosphere when said inner container is in said first position;

a glass ampoule having a sealed interior and a tip, said sealed interior containing said liquid bone cement component, said ampoule received within said interior of said inner container with said tip facing said inner container top end;

said bottom end of said inner container integrally formed with a cylindrical collar thereabout, said collar having a top portion of a defined extent and a bottom portion of another defined extent, said bottom portion having an inside surface and an outside surface, said outside surface provided with threads along said extent thereof, said top portion having an inside surface and an outside surface, said inside and outside surfaces of said top portion axially and integrally coextensive with said inside and outside surface of said bottom portion, said outside surface of said top portion including a grooved, annular flange at a first end of the top portion, said inside surface of said top portion being partially threaded at a second end, said grooved flange receiving an O-ring, wherein a rotation of said cylindrical collar in a first direction causes said O-ring to sealingly contact against said annular upstanding lip encircling said throughbore of said interlocking cover, said sealing contact of said O-ring occurring when said inner container is in said first position;

a cap having threads formed on an outside surface thereof, said cap threadably received within said bottom end of said inner container, said cap having an opening therein whereby atmospheric air is communicated through said cap and into said interior of said inner container, said inner and outer containers respectively having funnel-shaped top ends, with respective lower portions thereof defining respective neck members,

45 said funnel-ends concentrically arranged such that said inner container neck member is
frictionally received within said neck of said outer container when said inner container is
in said first position, said frictional contact creating a seal therebetween such that said
powder component is prevented from discharging out of said outer container, said inner
50 and outer container neck members simultaneously in communication with said mixing
chamber,

wherein a rotation of said cylindrical collar in a second direction opposite
to said first direction, causes a separation in the sealing contact between said inner and
outer containers and allows atmospheric air into said interior of said outer container, said
separation corresponding to said second axial position of said inner container, wherein said
55 powder between said containers descends into said mixing chamber and said liquid
component is released from said ampoule so that each of said components mix together
while descending into said mixing vessel under the vacuum existing therein, each of said
containers in communication with said atmosphere while said inner container is in said
second position such that no harmful emissions are released to the atmosphere.

3. The apparatus according to claim 2 wherein the inner container is
provided with brush-like devices in contact with the funnel-shaped end of the outer
container and so arranged so as to release the bone cement component in powder form
from the funnel-shaped port.

4. The apparatus of claim 2 wherein said interior of said inner container
includes an ampoule breaking means and a filter immediately therebelow, said means
including a plurality of internal passages for communicating said liquid component through
said means after said ampoule is broken.

5. The apparatus of claim 4 wherein said interlocking collar includes
an annular upstanding lip surrounding said throughbore and disposed away therefrom so
as to form an annular seat between said lip and said throughbore.

6. The apparatus of claim 5 wherein said cylindrical collar includes a
grooved, annular flange at a first end of said top portion thereof, and said inside surface

of said top portion is partially threaded at a second end thereof, said annular groove receiving an O-ring therein, wherein said O-ring sealingly contacts against said annular upstanding lip of said interlocking cover and said annular flange contacts against said annular seat of said interlocking cover when said inner container is in said first position.

7. The apparatus of claim 6 wherein rotation of said cylindrical collar in said second direction causes said annular flange to separate from said annular seat of said interlocking cover thereby separating said O-ring from said annular lip, said rotation continued until said neck member of said inner container is no longer contacting said neck member of said outer container.

8. An apparatus for successively feeding batches of a liquid and a powder component into an interior of a mixing vessel for preparation of a bone cement, said mixing vessel interior maintained under a vacuum created from a vacuum source, comprising:

a mixing vessel pre-filled with a powder component of said bone cement, said vessel defined by an outer wall having a top end, a bottom end and an interior, said top end formed with a sealable spout, said bottom end formed with an axially displaceable bottom;

an agitator received within said vessel interior, said agitator comprised of a tubular rod which extends upwardly out of said interior, through said spout, and an agitator disk attached to said tubular rod, an open, first end of said tubular rod defining a mouth and an open, second end of said tubular rod encircled by said disk, said tubular rod axially displaceable within said vessel interior for mixing said bone cement components;

a tightening rod disposed within said tubular rod for sealing said open bottom rod end from communication with the atmosphere;

a generally cylindrical container having a top, a bottom, and an interior, said inner container axially displaceable between a first and a second position, said bottom end in communication with said mixing vessel while in said first position, and while in said second position, said top end axially is displaced above said mixing vessel and no longer in communication therewith, said bottom end in communication with the atmosphere in

both of said positions;

25 a glass ampoule having a sealed interior and a tip, said sealed interior containing said liquid bone cement component, said ampoule received within said interior of said inner container with said tip facing said inner container top end;

30 a cap having threads formed on an outside surface thereof, said cap threadably received within said bottom end of said inner container, said cap having an opening therein whereby atmospheric air is communicated through said cap and into said interior of said inner container, said inner and outer containers having respective top ends which are funnel-shaped and respective lower portions defining respective neck members, said funnel-ends concentrically arranged such that said inner container neck member is frictionally received within said neck of said outer container when said inner container is in said first position, said frictional contact creating a seal therebetween such that said powder component is prevented from discharging out of said outer container, said inner and outer container neck members simultaneously in communication with said mixing chamber, said frictional contact creating a seal therebetween such that said powder component is prevented from discharging out of said outer container;

35 wherein said sealing rod is removed from said tubular rod and replaced with said container, said contents of said ampoule being downwardly fed into said tubular rod and entering said vessel interior near said bottom, as said liquid exits said open, second end, said leg and powder components mixing within said interior under vacuum, wherein air is communicated through said container and into said vessel through said tubular rod so that no harmful emissions escape to said atmosphere during mixing.

40 9. A method for successively feeding in an arbitrary sequence batches of a liquid and a powder bone cement component into a mixing vessel maintained under vacuum for the preparation of said bone cement wherein said mixing vessel is provided with a pre-determined amount of said powder component of said cement, the method comprising the steps of:

5 providing a mixing vessel, which said vessel is defined by a cylindrical cylinder having an open interior with a spout attached to one end of said cylinder, and having an axially displaceable bottom;

inserting a mixing agitator within said spout so as to communicate with said

10 vessel interior, said agitator comprised of a tubular rod having an agitator disk fixed on one end thereof, said other end being open and defining a mouth, said mouth being located axially above said spout of said vessel, said agitator axially displaceable such that said agitator disk can mix both of said bone cement components together;

15 providing a tightening rod within said tubular rod so as to seal said vessel from said atmosphere before said liquid component is introduced into said vessel;

removing said tightening rod and then introducing said liquid component into said interior of said vessel near said vessel bottom;

re-inserting said sealing rod within said tubular rod, thereby sealing said vessel from said atmosphere;

20 axially displacing said agitator so as to mix said liquid and powder components under vacuum, without allowing harmful emissions to escape said mixing vessel.

10. The method of claim 8, wherein said inner container has an open interior for receiving a glass ampoule and a threadable cap for pushing downwards on said ampoule, said interior including a means for breaking said ampoule when said cap pushes on said ampoule, thereby allowing said container to feed liquid into said vessel.

11. The method of claim 9 further comprising the step of placing said container in said mouth of said tubular rod.

12. The method of claim 9 further comprising the step of providing a hole in said container wall and connecting a tube between said container and vessel in order to feed said liquid through said tube to said container bottom.

13. The method of claim 8 wherein said container is a plastic bag containing said liquid and said container is provided with a tube that connects into said container wall in order to feed said liquid into said vessel at said bottom.

14. An apparatus for successively feeding batches of a liquid and a powder component into an interior of a mixing vessel for preparation of a bone cement,

532
5
said mixing vessel interior maintained under a vacuum created from a vacuum source in order to prevent harmful emissions from escaping from said vessel once said liquid and powder components are mixed, comprising:

a mixing vessel pre-filled with a powder component of said bone cement, said vessel defined by an outer wall having a top end, a bottom end and an interior, said top end formed with a sealable spout, said bottom end formed with an axially displaceable bottom;

10 means for introducing said liquid component into said interior of said mixing vessel through said sealable spout;

an agitator received within said vessel interior, said agitator comprised of a tubular rod which extends upwardly out of said interior through said spout and is in communication with the atmosphere and an agitator disk attached to said tubular rod, an open, first end of said tubular rod defining a mouth and an open, second end of said tubular rod encircled by said disk, said tubular rod axially displaceable within said vessel interior for mixing said bone cement components;

20 a removable tightening rod disposed within said tubular rod for sealing said open bottom rod end from communication with the atmosphere after said liquid component is introduced into said mixing vessel, said tightening rod being disposed within said tubular rod prior to introducing said liquid into said mixing vessel,

25 wherein said tightening rod is removed from said tubular rod immediately prior to introducing said liquid bone cement compound into said mixing vessel and is reinserted therein after said liquid is introduced within said mixing vessel, wherein said powder and liquid components are then mixed within said vessel interior under a continuous vacuum from said vacuum source and said atmospheric air is prevented from entering into said vessel due to said tightening rod, wherein said harmful emissions caused from mixing said components are prevented from escaping said vessel.

15. The apparatus of claim 14 wherein said means for introducing said liquid into said vessel is comprised of a container having an interior for containing said liquid, a tip, and a tube connected to said tip, said tube connecting said container to said mixing vessel.

16. The apparatus of claim 15 wherein said tube has a one end of said container inserted into said open top end of said tubular rod.

17. The apparatus of claim 15 wherein said tube has a one end inserted into said outer wall of said mixing vessel, near said bottom end.

18. The apparatus of claim 15 wherein said tip of said container is inserted into a funnel, said funnel having an open neck that is removably inserted into said open end of said tubular rod.

19. The apparatus of claim 15 wherein said plastic tube is provided with a clip for opening and closing said tube upon demand.

20. The apparatus of claim 18 wherein said container is comprised of one of a glass and plastic ampoule.

21. The apparatus of claim 18 wherein said container is comprised of a collapsible plastic bag.

22. The apparatus of claim 18 wherein said funnel has a component receiving area, which said area is enclosed by a cover having an opening and wherein said funnel neck is provided with a means for sealing said neck and said open end of said tubular rod.

23. An apparatus for successively feeding batches of a liquid and a powder component into an interior of a mixing vessel for preparation of a bone cement, said mixing vessel interior maintained under a vacuum created from a vacuum source in order to prevent harmful emissions from escaping from said vessel once said liquid and powder components are mixed, comprising:

a mixing vessel pre-filled with a powder component of said bone cement, said vessel defined by an outer wall having a first end, a second end and an interior, one of said first and second ends formed with a sealable spout, the other of said first and

second ends formed with an axially displaceable bottom, said bottom having a central opening therein;

an agitator received within said vessel interior, said agitator comprised of a tubular rod which extends upwardly out of said interior through said opening in said bottom and an agitator disk attached to said tubular rod, said tubular rod having an open, first end that defines a mouth and an open, second end that is encircled by said disk, said tubular rod axially displaceable within said vessel interior for mixing said bone cement components;

means for holding and introducing said liquid component into said interior of said mixing vessel,

wherein said means for holding and introducing is joined to said mouth of said tubular rod prior to feeding said liquid contents into said vessel through said tubular rod, wherein said powder and liquid components are mixed within said vessel interior under a continuous vacuum so that said harmful emissions caused from mixing are prevented from escaping said vessel, and wherein said mixed bone cement component is pushed out of said sealable spout through a displacement of said vessel bottom.

24. The apparatus of claim 23 wherein said means for holding and introducing said liquid components is comprised of a generally cylindrical container that is defined by a top, a bottom and an interior, said bottom having an opening therein that is in communication with said mouth of said tubular rod, said top having a removably threaded cap thereon for engagement with an ampoule containing said liquid, said ampoule received within said container interior and resting on a means for breaking said ampoule, said breaking means anchored to said container interior above said opening in said container bottom, said cap having a reclosable opening therein and a pair of shoulders in contact with said ampoule, said shoulders for pushing said ampoule against said breaking means through a downward threading of said cap, thereby breaking said ampoule so that said liquid is introduced into said tubular rod and into said mixing vessel.